

Claims

Cancel all claims of record and substitute amended claims 1, 4-6, 8, 11, 12, 15, and original claims 2, 3, 7, 9, 10, 13, 14, 16-19.. .

- 1 1. (currently amended): An apparatus for the collection and focusing of gas-phase ions
2 at or near atmospheric pressure for the introduction of said ions into an analytical
3 apparatus, the apparatus comprising:
 - 4 a. a dispersive source of ions.
 - 5 b. a stratified body consisting comprised of a plurality of elements, said elements
6 comprise alternating layers of metal electrodes and insulating material, each said
7 electrode having successively smaller apertures wherein said apertures form an
8 ion-funnel having an entry at largest aperture of first metal electrode and an exit
9 at smallest aperture of last metal electrode, said smallest aperture forming inlet
10 aperture into said analytical apparatus;
 - 11 c. first means for maintaining a potential difference between said ion source and
12 said metal electrode with largest aperture whereby electrostatic field at said
13 metal aperture with largest aperture which is equal to that required to pass
14 substantially all said ions through said largest aperture into said ion funnel;
 - 15 d. second means for maintaining a potential difference along the axis of said ion
16 funnel whereby electrostatic fields is equal to that required to pass substantially
17 all said ions through said ion funnel, through said inlet aperture, and into said
18 analytical apparatus.
- 1 2. (original): Apparatus as in claim 1 wherein said analytical apparatus comprises a
2 mass spectrometer or ion mobility spectrometer or combination thereof.
- 1 3. (original): Apparatus as in claim 1 wherein said inlet aperture comprises a
2 conductive end of a capillary tube, wherein said capillary tube is the atmospheric
3 or near atmospheric pressure inlet to the vacuum chamber of a mass
4 spectrometer.

- 1 4. (currently amended): Apparatus as in claim 1 wherein said gas-phase ions are
2 formed by means of atmospheric or near atmospheric pressure ionization,
3 electrospray, atmospheric pressure chemical ionization, laser desorption,
4 photoionization, or discharge ionization sources; or a combination thereof.

- 1 5. (currently amended): Apparatus in claim 1 further including a pure gas supplied
2 in such a way between the said inlet aperture and upstream adjacent metal
3 laminate, whereby substantially all said gas flows into and out through said ion
4 funnel flowing counter to trajectories of said gas-phase ions.

- 1 6. (currently amended): An apparatus for the collection and focusing of gas-phase ions
2 or charged particles at or near atmospheric pressure for the introduction of said ions
3 into the vacuum system of a mass spectrometer, the apparatus comprising:
 - 4 a. a dispersive source of ions.

 - 5 b. a laminated high-transmission surface populated with a plurality of openings
6 through which substantially all said ions pass unobstructed, said laminated high
7 transmission surface having a an insulating base and metal laminate on topside
8 and underside of said insulating base;

 - 9 c. a stratified body consisting comprised of a plurality of elements, said elements
10 comprise alternating layers of metal and insulating laminates, each said element
11 having successively smaller apertures wherein said apertures form an ion-funnel
12 having an entry at the largest aperture of first metal laminate and an exit at the
13 smallest aperture of last metal electrode said smallest aperture forming inlet
14 aperture into said vacuum system, whereby approximately all said ions from said
15 ion source pass unobstructed into said vacuum system of said mass
16 spectrometer;

 - 17 d. first means for maintaining a potential between said ion source and said
18 laminated high transmission surface which is equal to that required to cause

- 19 substantially all said ions from said ion source to migrate towards said metal
20 laminate on topside of said insulating base and pass through said openings in
21 said laminated surface, whereby electrostatic fields at said metal laminate on
22 said underside is greater than electrostatic field at said topside of said base;
- 23 e. second means for maintaining a potential difference between said metal laminate
24 on underside of said insulating base and said stratified body, whereby
25 substantially all ions from said high transmission surface pass into said entry of
26 said stratified body;
- 27 f. third means for maintaining a potential difference along the axis of said ion funnel
28 whereby electrostatic fields is equal to that required to pass substantially all said
29 ions ~~to~~ pass through said ion funnel, through said inlet aperture, and into said
30 vacuum system of said mass spectrometer.
- 1 7. (original): Apparatus as in claim 6 wherein said mass spectrometer is
2 configured with an ion mobility spectrometer, whereby ion analysis is performed
3 in a tandem manner.
- 1 8. (currently amended): Apparatus as in claim 6 wherein said gas-phase ions are
2 formed by means of atmospheric or near atmospheric ionization, electrospray,
3 atmospheric pressure chemical ionization, laser desorption, photoionization, or
4 discharge ionization sources; or a combination thereof.
- 1 9. (original): Apparatus in claim 6 further including a pure gas supplied in such a
2 way between the said inlet aperture and upstream adjacent metal laminate,
3 whereby substantially all said gas flows into and out through said entry of said
4 ion funnel flowing through said polarity of openings in said laminated high-
5 transmission surface flowing counter to trajectories of said gas-phase ions.
- 1 10. (original): Apparatus in claim 6 further including funnel-focusing and ring
2 electrodes incorporated in said metal laminate on underside of said insulating
3 base, said funnel-focusing and ring electrodes are supplied with fourth and fifth

4 electrostatic potentials, said funnel-focusing electrode is on-axis with said inlet
5 aperture while said ring electrode is axial symmetric with said focusing
6 electrode, wherein said funnel-focusing and ring electrode shape the
7 electrostatic field lines between said high transmission surface and said entry of
8 said ion funnel, wherein substantially all said ions passing through said
9 laminated surface are directed into said entry of said ion funnel and pass
10 through said ion funnel into said vacuum system of a mass spectrometer.

- 1 11. (currently amended): Apparatus in claim 6 further including particle stop in said
2 metal laminate on topside of said insulating base, said particle stop is an
3 electrode that shapes aides in shaping the electrostatic field lines at the top
4 surface of said laminated high transmission surface ~~between said high~~
5 ~~transmission surface~~, wherein substantially all said ions are diverted away from
6 said particle stop and pass through said laminated surface and substantially all
7 neutral particles from said ion source impact on said particle stop.
- 1 12. (currently amended): A Method method for the collection and transfer of charged
2 particles or ions from a highly dispersive area or source at or near atmospheric
3 pressure and focusing approximately all said charged particles or ions into a mass
4 spectrometer for gas-phase ion analysis, the method comprising:
 - 5 a. providing a perforated laminated high-transmission surface populated with a
6 plurality of holes made up of an insulating base and metal laminates contiguous
7 with topside and underside of said base;
 - 8 b. applying an electrostatic potential gradient across said laminated surface, such
9 that electrostatic field lines between said ion source and said laminated surface
10 are concentrated into said holes wherein substantially all said ions in said ion
11 source are directed through said holes into a focusing region downstream of
12 said laminated high-transmission surface;
 - 13 c. providing electrostatic attraction to said ions in said focusing region with an
14 electrostatic field generated by a stratified body or ion funnel, said ion funnel

15 made up of alternating electrodes and insulating bases, each said electrode
16 and base having successively smaller apertures, having an entry at the largest
17 aperture of first electrode and an exit or inlet aperture at the smallest aperture
18 of last electrode, said electrostatic attraction maintained by a potential gradient
19 across said electrodes wherein the electrostatic potential applied to each
20 electrode is greater than said electrostatic potential applied to adjacent or
21 upstream electrode, such that electrostatic field lines between said laminated
22 surface and said ion funnel are concentrated into said entry as a reduced
23 cross-sectional area;

24 d. directing substantially all said ions from said focusing region into said entry and
25 out of said inlet aperture, thereby focusing said charged particles into said
26 mass spectrometer.

1 13. (original): The method of claim 12 further comprising the step of directing
2 ions as they exit said inlet aperture by providing electrostatic or oscillatory
3 potentials to lens or electrodes, or combination thereof, in said mass
4 spectrometer.

1 14. (original): The method of claim 12 further comprising the step of directing a
2 flow of gas counter to the trajectories of said ions as they are directed
3 through said ion funnel.

1 15. (currently amended): A Method for the collection and transfer of charged
2 particles or ions from a highly dispersive area or source at or near atmospheric
3 pressure and focusing approximately all said charged particles or ions into a mass
4 spectrometer for gas-phase ion analysis, the method comprising:
5 a. providing a stratified body or ion funnel made up of alternating electrodes and
6 insulating bases, each said electrode and base having successively smaller
7 apertures, having an entry at the largest apertures of first electrode and an exit
8 or inlet aperture at the smallest aperture of last electrode;

- 9 b. applying an electrostatic potential gradient across said electrodes wherein the
10 electrostatic potential applied to each electrode is greater than said electrostatic
11 potential applied to adjacent or upstream electrode, such that electrostatic field
12 lines between said source of gas-phase charged particles or ions and said ion
13 funnel are concentrated into apertures of said ion funnel;
- 14 c. directing ions from said ion source into said largest aperture and out of the inlet
15 aperture, thereby focusing the charged particles into said mass spectrometer.
- 1 16. (original): The method of claim 15 wherein said ions are formed in a pulsed or
2 static fashion, or a combination thereof.
- 1 17. (original): The method of claim 15 wherein said method further includes the
2 step of operating said ion source in an oscillatory fashion by providing
3 oscillatory electrical potentials to said ion source.
- 1 18. (original): The method of claim 15 wherein said method further includes the
2 step of directing ions as they exit said inlet aperture by providing electrostatic
3 and oscillatory potentials to lens or electrodes in said mass spectrometer.
- 1 19. (original): The method of claim 15 wherein said method further includes the
2 step of directing a flow of gas counter to the trajectories of said ions as they
3 are directed through said ion funnel.